Manchester must be prepared to put its hand in its well-lined pocket for an equal amount to keep pace with science, which is now so mobile and so expensive. Dr. Clifford Allbutt delivered an address at St. Thomas's, which mostly consisted of a strictly logical defence of theory and abstract learning. Those who read carefully Dr. Allbutt's address will find more in it even than this. The apostles of empiricism, to whom the almighty fact is alone of importance, are the worst enemies of what may collectively be termed medical research. Their bourgeois utilitarianism prevents them from appreciating or forwarding any branch of inquiry connected with the medical sciences which does not immediately result in something of use. Research to them is the quintessence of an abstractitude.

This mental attitude of a part of the profession, which fortunately is getting less and less, finds its expression in the position adopted by the influential public and lay committees. It is somewhat anomalous—at any rate, it appears so—that astute financiers, practical men accustomed to weigh the chances of ultimate dividends in the most complicated concerns, should so discount pathological and pharmacological research. It must be known to them that a large proportion of the drugs they take, and the curative remedies they employ, are made in Germany, and that thousands of pounds are spent annually on German products of this class which might perfectly well be produced at home. Those of them who wander so far from the Stock Exchange as St. Dunstan's Hill will find there a whole colony of German firms which supply these articles. A public which will wait for years for dividends so far as concerns South African securities, which will fill up readily the gaps in a Cape to Cairo railway scheme, although this at present can only be done by a somewhat lively imagination, is inclined to push and accelerate the scientific worker, and expect maximum results in minimum time. The success of the German manufacturer in products such as therapeutic sera and synthetic drugs is simply due to the fact that the German capitalist has waited for his dividends which he is now getting. Apart from the standpoint of mere commerce, it is somewhat galling to know that a crude product like coal-tar is at present exported from this country, and re-imported worked up in the shape of dye-stuffs and drugs.

To work one must have a workshop; a palace one does not need. This forms another great difficulty with regard to medical research in London. The authorities at the London hospitals rightly regard the patients as having the first charge upon the space and accommodation at their command. Space in London, especially so far as concerns the older foundations—such, for instance, as St. Bartholomew's and Guy's—is necessarily very valuable. This subject formed the keynote of some of the speeches at the old students' annual dinner at St. Bartholomew's. The Great Hall was full of old Bartholomew's men, who, under the chairmanship of Dr. Lauder Brunton and the secretaryship of Mr. Bruce Clarke, met to inaugurate the new academic year. Dr. Lauder Brunton, in a short but effective speech, proudly stated that the hospital, so far as its essentially medical aspect went, left nothing to be desired; quite so much, however, could not be said for the laboratory accommodation. Sir Norman Lockyer, whose opinion upon the subject of experimental technique ought certainly to be final, also deplored this want of laboratory space in so old and famous a medical school. Many difficulties special to medical research were discussed by Sir Norman, and research in this branch of knowledge was compared to research in the physical sciences. One of the difficulties was the question of time. The worker in the fields of the medical sciences must solve his problems often at once. He must be an opportunist. Stars and planets remained more or less the same, but this was not so with disease. Pressure from without, according to Hunter, causes hypertrophy or overgrowth, pressure from within atrophy or waste. If the pharmacological laboratory at St. Bartholomew's is not in a condition of healthy overgrowth, it is certainly not because pressure from without is wanting, for, according to Dr. Brunton, its confines have been narrowed down to some fourteen square feet. It was reassuring to be informed by the treasurer, Sir Trevor Lawrence, that arrangements were on foot which would ensure more ample accommodation to laboratory workers at Bartholomew's.

The London Hospital was fortunate in securing the presence of Dr. Haffkine, who made an excellent and humorous speech. The St. George's students were addressed by Dr. Howship Dickinson upon "Medicine Old and New." Dr. Mitchell Bruce, at Charing Cross, took the "Outlook of Medicine" as the subject of his address. This was, he said, at the present time hopeful, since the scientific method was being pursued in every department of medicine.

In laying stress upon the special difficulties of the time, one is perhaps rather apt to forget the causative origin of all the inaugural addresses, viz. the medical student himself. He comes in ample numbers, a sufficient testimony to the healthiness of the profession he aspires to join, from year to year, sometimes partially prepared by the universities, sometimes raw from school, to struggle with those life-long difficulties of the healing art, compared to which even examinations count as nothing. For five years, now, he must suffer many things of divers examiners, and finally emerge to meet the great problem of his life—the human individual, both healthy and diseased. Exact knowledge in the sense of physical exactitude will probably be denied to as yet many generations of medical students, even concerning the main problems of disease, and in spite of the progress that, thanks mostly to careful and continual laboratory work, often of an apparently abstract nature, has during the last century been made, our knowledge even now serves often merely to illuminate our ignorance, and however optimistic our hopes for the future we are forced to admit that—

A thousand things are hidden still,
And not a hundred known.

F. W. T.

DARK LIGHTNING FLASHES.

IS there such a phenomenon as dark lightning? This is a question that has often been raised, and as yet no satisfactory answer has been given. If dark flashes do really occur, then they should probably be both seen and photographed, and the former, one would think, would be the more simple way of recording them. A difficulty, however, here arises, for if we assume that both dark and bright flashes occur during a thunderstorm, then we must be careful not to mistake retina-fatigue dark flashes for actual dark flashes if they exist. Lord Kelvin (NATURE, vol. lx. p. 341) has lately pointed out how, during a recent storm, he was able to confirm the existence of these *apparent* dark flashes; and in a more recent number of this journal (vol. lx. p. 391) I published some observations corroborating the same view. It must be pointed out, however, that, although such observations indicate that the majority of dark flashes seen may be attributed to the cause of fatigue of the retina, it does not necessarily follow that dark flashes do not actually occur. Eye observations, therefore, do not help us as yet to give a satisfactory answer to this question.

Let us turn now to photography, and see what evidence we can gather from photographs of flashes taken during thunderstorms.

In dealing with this mode of recording flashes, we are

again confronted with many difficulties, for the action of light on the sensitive film is capable of giving us both bright and dark images, although the object photographed is bright. We have, therefore, to contend with reversals, double reversals, &c., and many as yet unknown factors.

There is one point, however, that stands out foremost, and that is that the photographic plate has recorded many times dark as well as bright flashes; but whether the dark flashes are due simply to some action relative to the sensitive film, or are actual images of real dark flashes, is the very question that has so recently been revived.

What we really are greatly in need of is more data, and when a sufficient number of photographs of all kinds of lightning has been collected, more light will be thrown on this subject. Up to the present time, as each curious photograph of dark lightning was published, suggested theories as to the cause of the peculiarity of the flash have been by no means few in number, so that now the number of hypotheses equals, if not exceeds, that of the photographs examined.

In a very interesting article in this journal (vol. xlii. p. 151), which is an extract from a lecture on "Electrical Phenomena in Nature," delivered by Mr. Shelford Bidwell at the London Institution, the so-called "dark flash" is referred to in these terms.

"It occasionally happens that, on developing a photographic plate which has been exposed during a thunderstorm, the image of a lightning flash comes out black instead of white. . . . There is no need to discuss the several ingenious hypotheses which were suggested in explanation of the anomaly; it is sufficient to say that the mystery was completely cleared up a few months ago by the experiments of Mr. Clayden."

As I have no reference to Mr. Clayden's experiments at hand, I will quote from the above-mentioned abstract a brief summary of his hypothesis as described by the same writer.

"If the lens of the camera be covered the moment after a flash has occurred the developed image will always come out bright, feebly or strongly, according to circumstances. If, however, the plate be exposed after a flash has acted upon it, either to the continued action of a feeble diffused light or to the powerful glare arising from one or more subsequent flashes, then on development the image of the original flash will probably come out black. The effect is therefore not a meteorological or physical one, but purely chemical. It can be obtained, not only with a lightning flash, but also with a machine spark, or even with an ordinary flame. It is merely necessary that the plate should be exposed to the action of a certain amount of light after it has received the impression and before development."

At the present time Mr. Clayden's explanation may be looked upon as the most reasonable working hypothesis for future use. There is one crucial test which can be tried, which would settle once and for all its value. Unfortunately, so far as I am aware, this test has not yet been made, and I propose (and I hope others will as well) under the next suitable conditions to make the attempt. It is simply this. Take two cameras, say A and B, and orient them both in the same direction towards the point where the same flashes will come in both fields of view. Expose A for say fifteen minutes to record all the flashes that occur during that interval (some of these on development should be *bright*, some *dark*). Expose B for one flash only, preferably the first bright one which occurs during the exposure of A; this should develop *bright*. Compare the same flash on both negatives; that in A should be dark, that in B bright. If this be not the case, then I think the hypothesis breaks down. Perhaps this experiment may not be so easy to perform as it at first appears, for the difficulty lies in being able to catch one strong flash without exposing the plate to any light from other flashes which illuminate the sky, but are not in the field of view themselves. Several attempts by numerous observers would probably give us the information required.

With the object of firstly contributing data towards the interpretation of this curious and interesting phenomenon as recorded by the sensitive film, I give here some illustrations from absolutely untouched negatives of

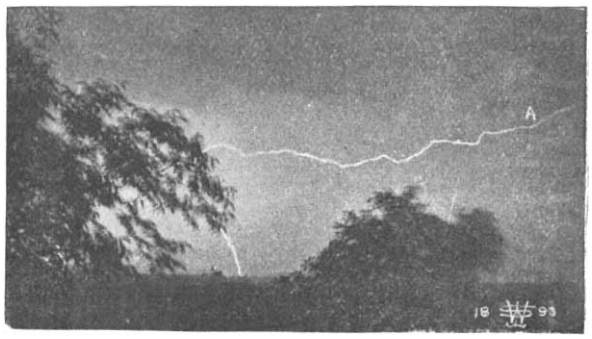

FIG. 1.—Lightning flashes taken during a thunderstorm at Göttingen, Germany, in 1893.

lightning flashes. All these reproductions are reduced about one-third.

I may perhaps preface my descriptions of the photographs by the remark that, having always taken a great interest in procuring lightning flashes by the aid of the camera, I have never, until this year, been fortunate enough in securing records of dark flashes. I have always previously exposed my plates or films for periods of fifteen minutes or more, depending on the strength and nearness of the storm. This fact at first suggested to me the idea that dark flashes might after all be real, but

FIG. 2.—Showing dark (A and B) and bright (C and D) flashes photographed at Westgate-on-Sea on August 5, 1899.

restricted to certain kinds of storms, the special peculiarities of which I cannot state.

Fig. 1 is a type of several negatives I have secured previous to this year, and although the exposure was twenty-five minutes in length, an examination of the negative shows absolutely no trace of any *dark* flash. The photograph, which was taken at Göttingen in North Germany, is interesting on account of the fine flash (A) which is traversing the air in a nearly horizontal direction and without any branches or ramifications. In the right-

hand corner will be noticed numerous flashes from clouds a great distance away.

I will now describe three of the four photographs I secured during the storm that passed over Westgate-on-Sea, Thanet, during the night of August 5 of this year (see letter, NATURE, vol. lx. p. 391); all four show

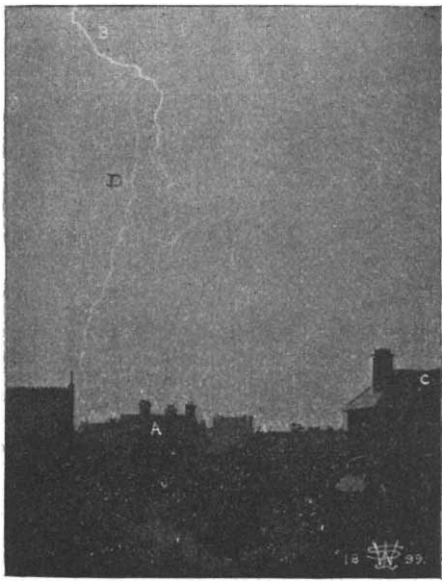

FIG. 3.—Showing bright (B and D) and dark (A and C) flashes photographed at Westgate-on-Sea, on August 5, 1899.

dark as well as bright flashes. The camera employed was one of those excellent and handy little 5 × 4 daylight folding Kodaks, and the exposure in each case was fifteen minutes. The storm, I may add, passed roughly from S.E. towards N.W., and my camera was placed on a window-sill facing due north.

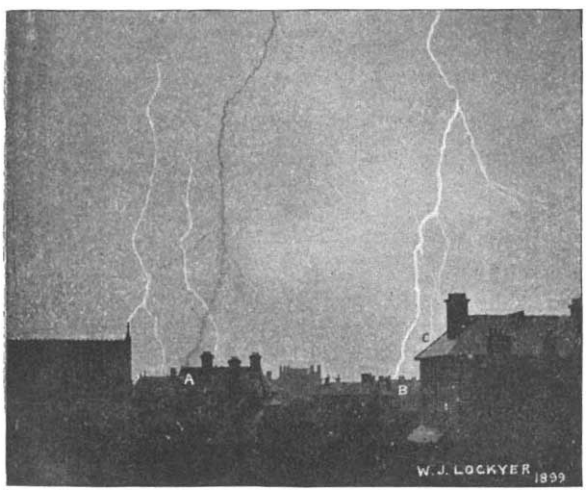

FIG. 4.—Showing bright (B and C) and dark (A) flashes photographed at Westgate-on-Sea, on August 5, 1899.

Fig. 2, showing the north-western sky, displays several flashes, the most prominent of which are C and D bright and A and B dark. The bright flashes have no ramifications, while the dark distinct flash A has several dark. It may be that B is only a large ramification of A, but it is difficult to say.

Fig. 3. The northern sky as here shown displays four prominent flashes, A and C dark and B and D bright. B, as will be noticed, appears to take a very circuitous path, which resembles very closely that illustrated in a previous number of NATURE (vol. xlii. p. 152), and which was a reproduction from a photograph taken on June 6, 1889, by Mr. Rose at Cambridge.

The last, and, I think, absolutely unique photograph of

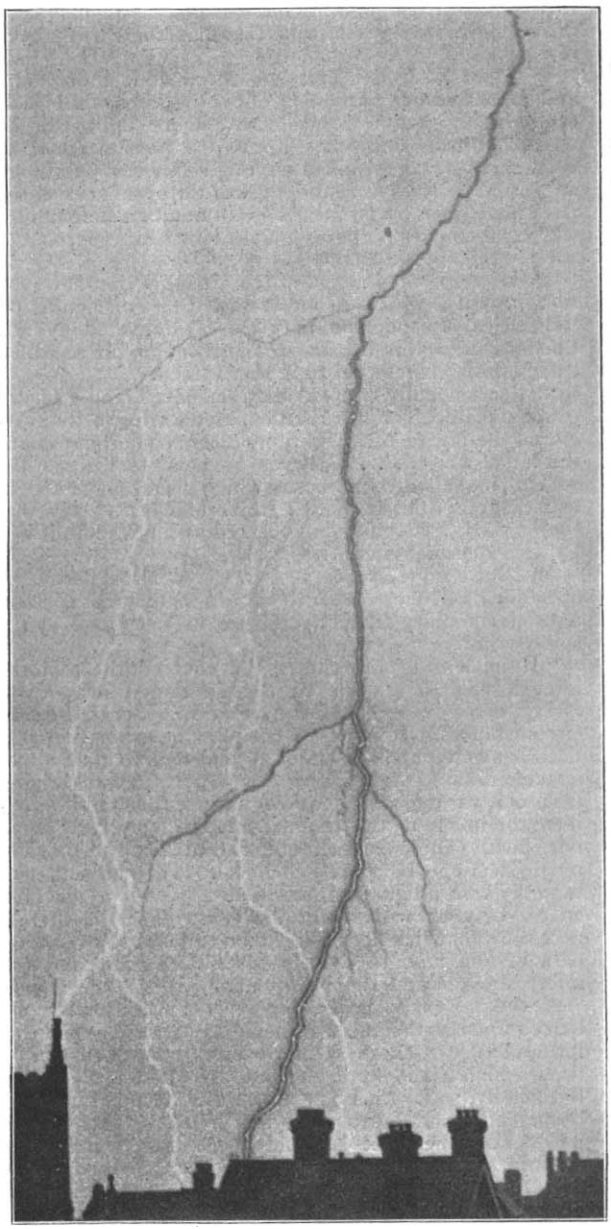

FIG. 5.—Enlargement of dark flash A in Fig. 4.

a dark flash, is illustrated in Fig. 4. The negative was exposed when the storm was perhaps just a little north of my position (camera pointing due north). The two most prominent flashes are those marked A and B. B is the ordinary bright flash with numerous bright ramifications, while A is also equally, if not more, strong but *dark* with *dark* ramifications. An enlargement of this flash is shown in Fig. 5. Most interesting,

however, is the *reversal*, which extends nearly the whole way up the centre—that is, the dark flash has along its centre a bright core. It is this very photograph which made me cast doubt on the hypothesis suggested by Mr. Clayden, for both a very strong flash can be recorded *very* dark (with a reversal), and also a weak flash (see Fig. 2, B). If the reader refers to an interesting article on "Lightning," by Mr. Jeremy Broome, that appeared in the January number of the *Strand Magazine* in 1897, there will be found a reproduction of a photograph taken at Cambridge by Messrs. Valentine Blanchard and Lunn, showing a *bright* flash with a *dark* reversal down the centre, the exact opposite to the flash recorded above. It may be remarked that a reversal is perfectly distinct from a double flash, many of which have been recorded.

Another flash of interest and peculiarity is that marked C. This flash is quite distinct from B, but unlike all the other bright flashes of about the same intensity, which are clear and sharply defined, this one is occasionally split up along its path into two parts, and the *flash on both sides throughout its whole length is bounded with dark borders*. Both the original negative and a silver print show this peculiarity distinctly, but unfortunately the dark borders are lost in the reproduction. I find that this peculiarity about a flash has been photographed before, but apparently not noticed. If the reader will refer to an old number of *Knowledge* (vol. xviii. p. 224), he will find a reproduction of a lightning flash taken by Mr. George Primavesi at Tooting. This flash is far more intense than that on my negative, and the dark borders are more developed. The main stream is devoid of ramifications: the exposure lasted for only one second.

To sum up, then, the different appearances of the lightning flashes recorded in these photographs, and others of which I possess either photographs or reproductions; we have the following various kinds :—

Main stream.	Ramifications.	Reversal down centre.	Source of information.
Bright	None		Fig. 1, A
,,	Bright		Fig. 4, B
,,	Dark		NATURE, vol. lx. p. 423
,,	None	Dark	*Strand Magazine*, Jan. 1897, p. 41
,,	Bright	Dark	?
,,	Dark	Dark	?
Dark	None		Fig. 3, A
,,	Dark		Fig. 2, A
,,	Bright		?
,,	None	Bright	?
,,	Dark	Bright	Fig. 4, A
,,	Bright	Bright	?

The peculiar flash marked C in Fig. 4 I have not inserted in the above table, as it is difficult to decide under which category it should be placed.

Now in attempting to explain the cause of dark lightning I employed Mr. Clayden's idea as a working hypothesis, but I can find no reference to any illustrations of the experiments he carried out. Mr. Shelford Bidwell, however (NATURE, vol. xlii. p. 153), describes and illustrates one out of a series of experiments he made, and this shows dark and bright flashes made artificially, but the flashes are simply dark or bright, with no other peculiarities.

Further, in a letter which appeared in a very recent issue of this journal, Mr. F. H. Glew mentions that he also has made several experiments with regard to the Clayden effect. The illustration which accompanies his account of these investigations (the *Photographic Journal*, vol. xxiii. No. 7, p. 179) shows, like Mr. Bidwell's, no more than simple dark and bright flashes. I may here mention that the method described by me further on was not very dissimilar to that employed by Mr. Glew, although I was unaware until quite recently of the publication of his to which reference has just been made.

Now the point most interesting to me was, Could one artificially produce on one plate or film *exact* types of dark and bright flashes as shown in the above illustrations; that is, flashes which are dark with *bright cores* and bright with *dark borders?* No photographs of sparks produced artificially have, so far as I know, displayed any of these peculiarities.

I will simply describe one experiment that I made, with this object in view, in the laboratory of the Solar Physics Observatory, Kensington.

To produce the spark I employed a 10-inch Apps' coil, with a pint jar in circuit, fed by two cells of four volts each, the sparking distance being two inches. The camera was a small 5 × 4 by Herr Winkel of Göttingen, fitted with a Zeiss objective. Although it was made only

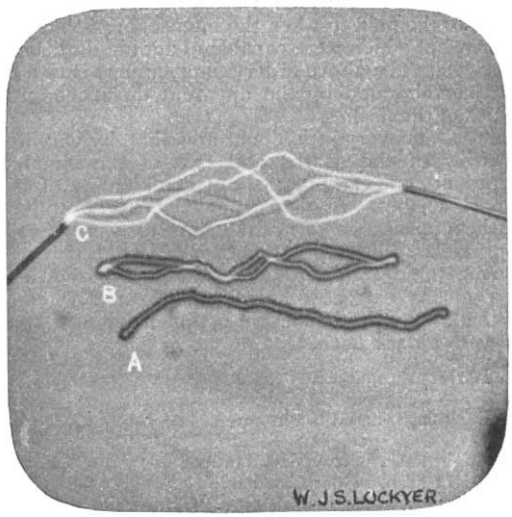

FIG. 6.—Showing three series of sparks taken on one plate against a white background. During the passage of the sparks at C, the background was artificially illuminated.

for the use of glass plates, by a simple device Eastman's film could be employed. Films, I may mention, eliminate all chances of halation.

The method of procedure was as follows :—

In a darkened room I first of all made an exposure on a *single* (2-inch) spark against a bright (white cardboard) background. On development this bright flash came out naturally *bright*.

I next inserted a new film and repeated the same experiment, except that I did not remove the film or develop it immediately. Covering up the lens carefully, I moved the poles in a vertical plane so that the next spark should fall on a different part of the film, and made a second exposure on two sparks. Again covering the lens, and moving the poles a little in the same direction, I exposed the film once more to a series of four sparks, *but while I allowed the sparks to pass I illuminated the cardboard background by burning one inch of magnesium ribbon at a distance of two feet.*

It may be mentioned that the poles only appear on the negative in their respective positions when the background is artificially illuminated. Fig 6 shows the results obtained. A is the first spark, B the two sparks after the first movement of the poles, and C the last four flashes when the background was artificially illuminated.

A close examination of the figure shows that, not only do we get types of simple bright flashes, but we obtain dark flashes with bright cores and bright flashes with dark boundaries.

Now A (Fig. 6) is exactly similar in type to the dark flash in Fig. 4, A, while the two bright flashes in C correspond also to the bright flashes in Fig. 6.

The peculiar flash at C (Fig. 4) is an exact counterpart of D in Fig. 5.

This experiment leads me to conclude, therefore, that Mr. Clayden's hypothesis is entirely corroborated, and explains very satisfactorily the types of flashes illustrated in the above reproductions from photographs.

In studying Fig. 4 in the light of these results, we can form a good idea of the order of appearance of the flashes. That marked A was undoubtedly the first to occur (if the plate had been immediately developed, it would have come out bright); then the flash B made its appearance, and, being so intense, illuminated the neighbouring region round A that the image of A on the film was affected chemically. C was probably next in order of occurrence, but, being more distant and therefore fainter, did not have any effect on A or B. C, however, was affected by subsequent flashes, which were not bright enough to illuminate the field to alter the intense bright flash B in any way, but which were capable of adding dark borders to its sides. The above order of appearance is to a great extent corroborated by the apparent distances and intensities of the flashes.

There seems very little doubt now that, by varying the intensities of the sparks and that of the illuminated background, one can produce any combination of bright and dark flashes. A glance again at Fig. 6 will show that the appearance of a flash depends simply on the magnitude and presence or absence of the core. The following table sums up the six chief types of flashes that probably can be obtained: the reader will notice that there is a complete cycle commencing and terminating with a dark flash.

1. Dark flash, no core.
2. ,, ,, small bright core.
3. Dark flash, broad bright core; or, Bright flash, narrow dark borders.
4. Bright flash, *no* dark borders.
5. ,, ,, small dark core. This would represent an ordinary weak reversal.
6. Bright flash, broad dark core; or, Dark flash, narrow bright borders. This would represent an ordinary strong reversal.
7. Dark flash, *no* bright borders; or, same as No. 1 above.

In the above list photographs have *actually* been obtained of all the types of flashes that came under the headings 1–5. I have examined all my *negatives* to search for the type No. 6, with the result that I have not found a representation of this kind of flash.

It may be remarked that the types 1–3 are produced as a direct consequence of the Clayden effect, and should therefore only appear on plates which contain more than one flash. The other types, which depend simply on the intensity of the flash, should be obtained when even only one flash appears on a plate.

We thus see that actual photographs of lightning bear out what we should expect from laboratory experiments, and we must therefore answer in the negative the question asked in the first line of this article.

Dark lightning flashes therefore do not exist in nature, but their appearances on photographs are due to some chemical action which takes place in the gelatine film.

In closing this article I wish to draw attention to the great interest which is attached to this most fascinating subject. Every one who has a camera can help in the elucidation of the several points to be studied, and most probably bring new facts to light. The photography of lightning flashes during the night is an easy subject, for one has simply to turn the camera towards the dark sky, and the lightning does all the exposing itself. Unfortunately it is not every one who is aware of this fact, and I know of two instances of amateurs who exposed plates during the same storm and at the same place where I obtained the above pictures, but they tried to *catch the flashes by using instantaneous shutters*. Whether they obtained any positive results I do not know, but one could make a very fair guess.

If any readers of this article would be willing to exchange interesting unmounted lightning photographs obtained by them for copies of any of the above illustrations from the original negatives, the writer would esteem it a favour. (Address: 16 Penywern Road, South Kensington, S.W.) This request suggests to me that it would be important for the furtherance and development of this subject, if there were some recognised "Central-Stelle" to which copies of all such photographs could be sent. Those studying the subject would not then be so much hampered in searching for references to accounts of original observations and reproductions, if a fairly complete collection of copies from original negatives were made accessible. WILLIAM J. S. LOCKYER.

NOTES.

PROF. A. GRAY, F.R.S., Professor of Physics in the University College of North Wales, has been appointed to succeed Lord Kelvin in the chair of Natural Philosophy in the University of Glasgow, and will at once commence his new duties.

THE Harveian Oration will be delivered at the Royal College of Physicians, London, on October 18, by Dr. G. Vivian Poore, and the Bradshaw Lecture on November 2, by Dr. A. Foxwell.

MAJOR RONALD ROSS and other members of the Liverpool Malaria Expedition have returned to this country very well satisfied with their labours. On the advice of the expedition the authorities at Sierra Leone decided to use every means to exterminate the malaria-spreading mosquito. Major Ross is of opinion that the white population is not careful enough, and that the houses are badly constructed, and compare unfavourably with the residences of white people in India, which are constructed on plans that give the inhabitants every chance of health, despite the tropical climate. He attaches great importance to this question of the construction and situation of the houses. Dr. Fielding Ould, a member of the expedition, has remained behind to consult with the medical officers on the coast respecting measures to be taken for the extermination of the malarial mosquito in the neighbourhood of the principal towns. During the investigation one member of the expedition, Mr. Austin, suffered from malaria; he became infected through sleeping one night without the protection of mosquito curtains.

DRS. CALMETTE AND SALEMBENI, who were sent out by the Pasteur Institute as a commission to study and combat the plague in Oporto, have returned to Paris more than satisfied, it is said, with the success attending their efforts with the anti-plague serum. Dr. Calmette is of opinion that the Portuguese might easily free themselves from plague if they would rigorously carry out the measures which have been recommended to them, and in particular if they would inoculate all the inhabitants of suspected quarters. This, however, they appear unwilling to do.

ACCORDING to the *Civil and Military Gazette*, Lahore, the Indian Government has under its consideration a somewhat comprehensive scheme for the establishment of research laboratories